might be expected, as Nos. 2 and 3 are obviously descended from the hermaphrodite No. 1. I have never, however, found a single individual in any sense intermediate between Nos. 2 and 3, which appear to be two distinct female forms developed from No. 1 along different lines.

These two forms, it will be observed, differ remarkably from each other in the following points, viz. size of capitulum, size of florets and arrangement on the receptacle, colour of corolla, stoutness, colour and general form of style, and in the absence or presence of stellate hairs.

The stellate hairs are utilized to catch stray pollen-grains detached from the bodies of insect-visitors coming from neighbouring hermaphrodites, most of which would otherwise be wasted. As it is, they are retained by the hairs until the arrival of other insects, which in depressing the already bent and twisted styles bring their viscid stigmas into contact with the pollen-grains collected by the hairs of adjacent florets—a result facilitated by the manner in which the stigma is set on the style. By this arrangement the chances of fertilization are much increased, as each stigma generally receives a full share of pollen.

With regard to the relative size of the three forms it is remarkable that while one of the female forms is so much smaller than the hermaphrodite (as is the case, according to Darwin, in all gynodiœcious species known to him), the other even exceeds it in size. It is also noteworthy that the capitulum of the second female form, although larger than that of the hermaphrodite, contains a much smaller number of florets, and these are very large.

I can discover no rule as to the distribution of the different forms. In one station near here (a large common) all the plants are hermaphrodites. In a certain wood where the species abounds, the "bent-styled" females appear to be nearly as common as the hermaphrodites, while no "straight-styled" females can be found. In another wood, not half a mile distant from the first, the "bent-styled" form is almost entirely supplanted by the "straight-styled," which is plentiful. Lastly, in a fourth station (a barren strip of ground by the roadside), all three forms are found growing together. ARTHUR TURNER.

Box Hill, September.

On the Aquatic Habits of Certain Land Tortoises.

IT has always proved of more or less interest to me to observe the method of aquatic locomotion adopted on the part of any of our strictly terrestrial vertebrates, and never is this more keen than when the opportunity has been afforded to study the swimming propensities of certain of our Reptilia. Most snakes swim well, but who of us has not been surprised upon first observing the violent wriggling, froward-propelling motions of some of the smaller lizards when they are thrown out into the water some little distance from the shore? The American chameleon (*Anolis principalis*) well illustrates this last; and this lizard, in common with others, seems to possess an actual dread of getting into deep water. For a long time it has been known that most species of the so-considered stricter types of land tortoises soon drown when placed in water of any considerable depth, and it would be but natural to suppose that such species would avoid that element as far as possible, but I have found this by no means always to be the case. Take the ordinary land turtle of the United States (*Cistudo carolina* for example: it will voluntarily enter the water under certain circumstances. Not long ago the writer noticed one of these hunting for food in three or four inches of water along the edge of a pond that had rising banks; and the first time I discovered the nest of this variety the eggs were deposited in the water in a depression at the miry margin of a marsh. But this is not all, for if we place one of these reptiles upon a little island of land, well removed from the shore, and surrounded by water several feet in depth, and withdraw to watch its movements, we note that as soon as it satisfies itself as to its position, it will, without further ado, take at once to the water and swim to the nearest shore. It does not, however, sink beneath the surface, but, holding its head high out of that element, and filling its lungs with air, strikes out vigorously, with alternate pairs of feet, until it accomplishes its purpose, and regains the mainland. How far one could swim in this manner I am unable to state, but that it would not exceed a few yards I am quite certain. Nevertheless, even the power to accomplish the feat to the extent indicated might, under a variety of circumstances, have its influence upon the distribution of the species, or of any species of typical land tortoise, and it would be interesting to know how far this power may be enjoyed by this class of reptiles generally.

Smithsonian Institution, R. W. SHUFELDT.
Washington, D.C., September 13.

Delambre's Analogies.

FOUR of the most important formulæ in spherical trigonometry were given by Gauss, without proof, in his "Theoria Motus Corporum Cœlestium" (1809), and were therefore called Gauss's theorems or analogies.

They were, however, given by Mollweide in Zach's *Monatliche Correspondenz* for November 1808, and before that by Delambre in the *Connaissance des Temps*, issued in April 1807, so that they are now justly ascribed to the latter.

They may be deduced in the most simple manner from Napier's analogies, and thus easily remembered.

Napier's analogies are—

$$\tan \tfrac{1}{2}(A + B) = \frac{\cos \tfrac{1}{2}(a - b)}{\cos \tfrac{1}{2}(a + b)} \,.\, \cot \tfrac{1}{2}C \qquad (\alpha)$$

$$\tan \tfrac{1}{2}(A - B) = \frac{\sin \tfrac{1}{2}(a - b)}{\sin \tfrac{1}{2}(a + b)} \,.\, \cot \tfrac{1}{2}C \qquad (\beta)$$

$$\tan \tfrac{1}{2}(a + b) = \frac{\cos \tfrac{1}{2}(A - B)}{\cos \tfrac{1}{2}(A + B)} \,.\, \tan \tfrac{1}{2}c \qquad (\gamma)$$

$$\tan \tfrac{1}{2}(a - b) = \frac{\sin \tfrac{1}{2}(A - B)}{\sin \tfrac{1}{2}(A + B)} \,.\, \tan \tfrac{1}{2}c \qquad (\delta)$$

$$\text{Let } m \,.\, \sin \tfrac{1}{2}(A + B) = \cos \tfrac{1}{2}(a - b) \cos \tfrac{1}{2}C \,. \qquad (1)$$

$$\therefore\; m \,.\, \cos \tfrac{1}{2}(A + B) = \cos \tfrac{1}{2}(a + b) \sin \tfrac{1}{2}C \,. \qquad (2)$$

These are numerator and denominator of (α).

$$\text{Let } n \,.\, \sin \tfrac{1}{2}(A - B) = \sin \tfrac{1}{2}(a - b) \cos \tfrac{1}{2}C \,. \qquad (3)$$

$$\therefore\; n \,.\, \cos \tfrac{1}{2}(A - B) = \sin \tfrac{1}{2}(a + b) \sin \tfrac{1}{2}C \,. \qquad (4)$$

Numerator and denominator of (β).

Square, and add—

$$\therefore\; m^2 + n^2 = 1.$$

Divide (4) by (2), and it follows by (γ) that—

$$\frac{n}{m} = \tan \tfrac{1}{2}c\,;$$

$$\therefore\; m = \cos \tfrac{1}{2}c,\; n = \sin \tfrac{1}{2}c.$$

Substitute these values, and (1), (2), (3), (4), are Delambre's analogies. R. CHARTRES.

Classified Cataloguing.

THE principle suggested by Mr. Petrie, on "Classified Cataloguing" (NATURE, August 22, p. 392), is already successfully used in many of the chief libraries of the United States, having been originated by Mr. Melville Dewey, while Librarian at Amherst College. It is equally applicable to collections of all kinds, and the classification has already been extended to a considerable extent in certain departments, particularly in botany, and is capable of unlimited extension. It possesses all the advantages mentioned by Mr. Petrie, but is broader, inasmuch as it includes all subjects.

In the "Decimal Classification" of Mr. Dewey (Boston, 1885, second edition), we find, for illustration, under 500, General Science; 580, Botany; 583, Dicotyledonæ; 583·9, Apetalæ; 583·95, Unisexuales, 583·951, Euphorbiaceæ; 590, Zoology; 598, Reptiles; 598·13, Chelonia, &c.

If an extension of this system, which would, I have the means of knowing, be most acceptable to Mr. Dewey, were to be adopted for general museum use, the advantages would be incalculable. JAS. LEWIS HOWE.

Polytechnic Society, Louisville, Kentucky.

Valuable Specimens of Vertebrates for Biological Laboratories.

WHAT specimens of Vertebrates are the best to be used by the student in the biological laboratory? This is certainly a very important question. In Europe, the following animals are generally dissected: some fish, the common frog, the pigeon,

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the rabbit, or the guinea-pig. The frog is a very aberrant member of the Batrachia, and it would be very instructive for the student to examine a more typical representative of the class. Such a one is the American Proteus (*Necturus maculatus*, Ref.), used at Cornell University, Ithaca, N.Y. During the last few years I have received many specimens of Vertebrates from two fishermen—Mr. Russell Dee and Mr. F. C. Audibert, from Marietta, Ohio. Lately, Mr. Audibert has written to me that he could procure any quantity of material, if wanted, and he would charge only 25 cents. (a little over one shilling) for each specimen. From the list of specimens sent to me by Mr. Audibert I select the following, which appear the most important for laboratory use:—

Accipenser maculosus, Les.
Polyodon folium, Lat.
Lepidosteus osseus, L.
Necturus maculosus, Ref.
Menopoma alleghaniensis, Daud.
Trionyx muticus, Les.

The instructive value of these specimens is certainly very great, and the low price could enable any biological laboratory to secure this material. G. BAUR.

New Haven, Conn., September 30.

"Darwinism."

IT has now become to me a matter of amusement to note how those naturalists who of late years have drifted most widely from the doctrines of evolution as these were held by Darwin, habitually accuse me of Darwinian heresy because I have not seen any adequate reason to depart from those doctrines in their entirety. Perceiving that there has been some change of relative position, while failing to perceive that the movement has been altogether on their own side, these naturalists represent that I have been falling away from Darwinism, when the fact is that they have been advancing beyond anything that was ever countenanced by the judgment of Darwin—and even expressly accepting the view which he so vehemently rejected, viz. that of regarding natural selection as the sole cause of organic evolution. Thus, for example, when in NATURE of October 10 (p. 569) Prof. Ray Lankester gravely designates my paper on physiological selection a "laborious attack upon Darwin's theory of the origin of species," it becomes evident how fast and far he has travelled from his Darwinism of two or three years ago. For, to put it briefly, unless it can be shown that Darwin considered natural selection the only possible cause of organic evolution, and did not consider sterility between allied species as probably due to some other principle of change, it is obvious that there *can* be nothing in my "additional suggestion on the origin of species" which may in any sense be designated an attack upon the distinctively Darwinian theory. Yet it is with regard to these very points that the opinion of Darwin was steadily opposed to that of Wallace; *i.e.* to the present opinion of Lankester. Therefore, quite apart from any question touching the truth of this "additional suggestion" or "supplementary hypothesis" (which, however, I may here parenthetically remark, will soon be shown to be in no way seriously affected by Mr. Wallace's sole remaining criticism), it is sufficiently evident that, when the object of publishing the hypothesis was expressly and repeatedly stated to have been that of meeting the main difficulties which had been advanced against the theory of natural selection, the present designation of this hypothesis as an elaborate attack upon that theory is simply absurd.

But my object in now writing is to state, *apropos* of Prof. Lankester's remarks on the inadequacy of Mr. Wallace's criticism of Mr. Gulick's paper, that I have just received a communication from the latter gentleman (who writes from Japan), requesting me to exercise my discretion as to publishing in these columns a reply to that criticism. Unfortunately this reply is too long for insertion, and as I do not see how it can be curtailed without serious detriment, I have refused to incur the responsibility of publishing it in an abbreviated form. At the same time it seems but just to let the readers of NATURE know that a full reply to Mr. Wallace's criticisms (in these columns and elsewhere) has been prepared; since otherwise the silence of its author might be misinterpreted.

To me it appears that Mr. Gulick's work is much the most profound that has ever been published on the important matters of which it treats (viz. isolation in all its forms, with its consequences in "segregate breeding" and "divergent evolution"); and therefore I am glad to take this opportunity of recognizing his priority, by some fifteen years, in thinking out, and largely verifying by his researches on land shells, the theory of physiological selection. GEORGE J. ROMANES.

Geanies, Ross-shire, October 12.

Sunset Glows.

IT is a curious fact that a revival of sunset-glows, similar to those described by Sereno E. Bishop in a letter published in NATURE for August 29 (p. 415), was observed in Western New York at almost precisely the same time that he saw them at Honolulu. I inclose a clipping from the *Rochester* (N.Y.), *Democrat and Chronicle*, which was published on July 21:—

"The skies at evening show signs of the gradual return of the red light. It will be of interest to ascertain if the phenomenon reappears as the solar disturbances continue to increase in energy to the maximum. It is quite apparent now that the minimum has been passed, and the tendency is toward an increase in the number and in the violence of solar disturbances. There are certainly three and probably four well-defined disturbances at present." M. A. VEEDER.

Lyons, New York, September 13.

"The Teaching of Science."

I BEG that the following alterations may be made in the "Suggestions for a Course of Elementary Instruction in Physical Science," printed in NATURE of October 17.

HENRY E. ARMSTRONG.

P. 602, Problem II., line 11 from above, read "by means of iron" instead of "by means of phosphorus."

P. 603, Problem VII., line 20 from below, instead of "when metals are heated with acids," read "when metals are dissolved in acids."

P. 604, Problem IX., line 31 from above in right-hand column, read "dried hydrogen," instead of "dried oxygen."

P. 605, Problem XII., line 17 from above in right-hand column, read "zinc oxide," instead of "lime oxide."

TELESCOPES FOR STELLAR PHOTOGRAPHY.[1]

II.

IN considering the essentials of a good system of control for equatorial clocks, it is necessary to keep in view the exact conditions required. It is not sufficient that the controlling apparatus (of whatever form it may be) should simply bring the *rate* of the clock, which has been interfered with by some adventitious disturbance, correct once more; it must do more, it must correct this error. For, suppose a star be set on the slit of a spectroscope, and the clock started, and say, as in Dr. Huggins's case, a photographic plate inserted for a two hours' exposure. Now suppose that five minutes after the commencement of the exposure, an error of one-tenth or two-tenths of a second occurs from some disturbing cause (a fragment of dirt on the tooth of a wheel, or other cause); if the controlling apparatus be of such a nature as simply to bring the clock-rate correct again, the position of the telescope will be the above quantity, one-tenth or two-tenths of a second, in error for the remainder of the exposure, although the rate may be absolutely correct for the whole times. In other words, the star will have moved off the slit, by a quantity equivalent to what the instrument would move in one-tenth or two-tenths of a second, and will continue off the slit for the remainder of the two hours. So it will be seen that no controlling apparatus is of any use whatever, unless, as well as keeping the rate uniform, it corrects the errors that have crept in. In consequence of not keeping this point in view, many most ingenious but useless arrangements have been from time to time proposed. A little consideration will show that this arrangement meets all requirements.

The above arrangement is somewhat similar to Dr. Gill's.

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[1] A Paper read by Sir Howard Grubb, F.R.S., before the Society of Arts, on April 18, 1888. Continued from p. 444.

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